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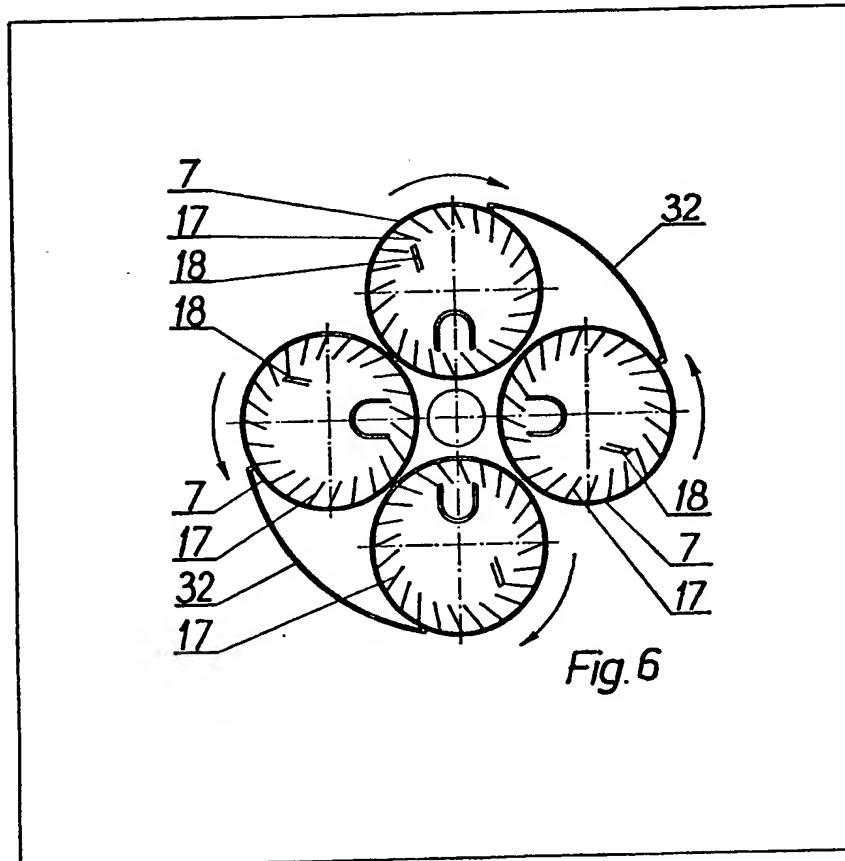
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## (54) Centrifuges

(57) A continuous planetary type filtering or settling centrifuge designed for separating mixtures containing solid and liquid comprises several filtering or settling baskets which rotate about their individual axes as well as about a common central shaft (2), and angled baffles 17 are arranged inside the baskets, which prevent a displacement of the mixture along the circumferences of the baskets, thus preventing damaging of the centrifuged solid and the filtering screens in case of the filtering cen-

trifuge, and also facilitate drain off liquid from the basket in case of the settling centrifuge. The filtering or settling baskets have means for feeding the mixture to be centrifuged and discharge chutes which may incorporate worms. Also means may be provided at different zones round the baskets for washing the solid with a liquid or treating it with steam, separating of the washing liquid or steam, drying of the solid, and washing of filtering screens.



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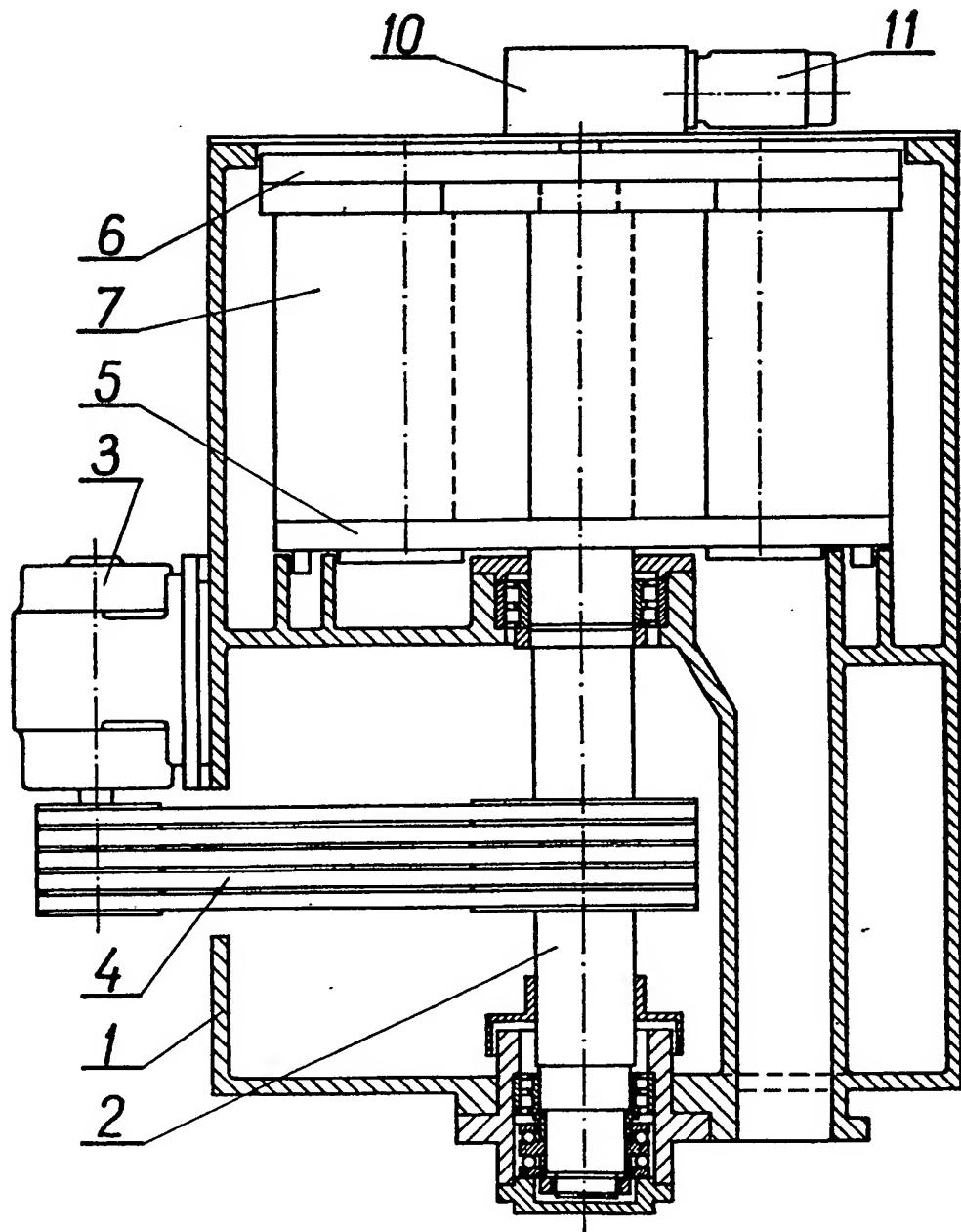


Fig. 1

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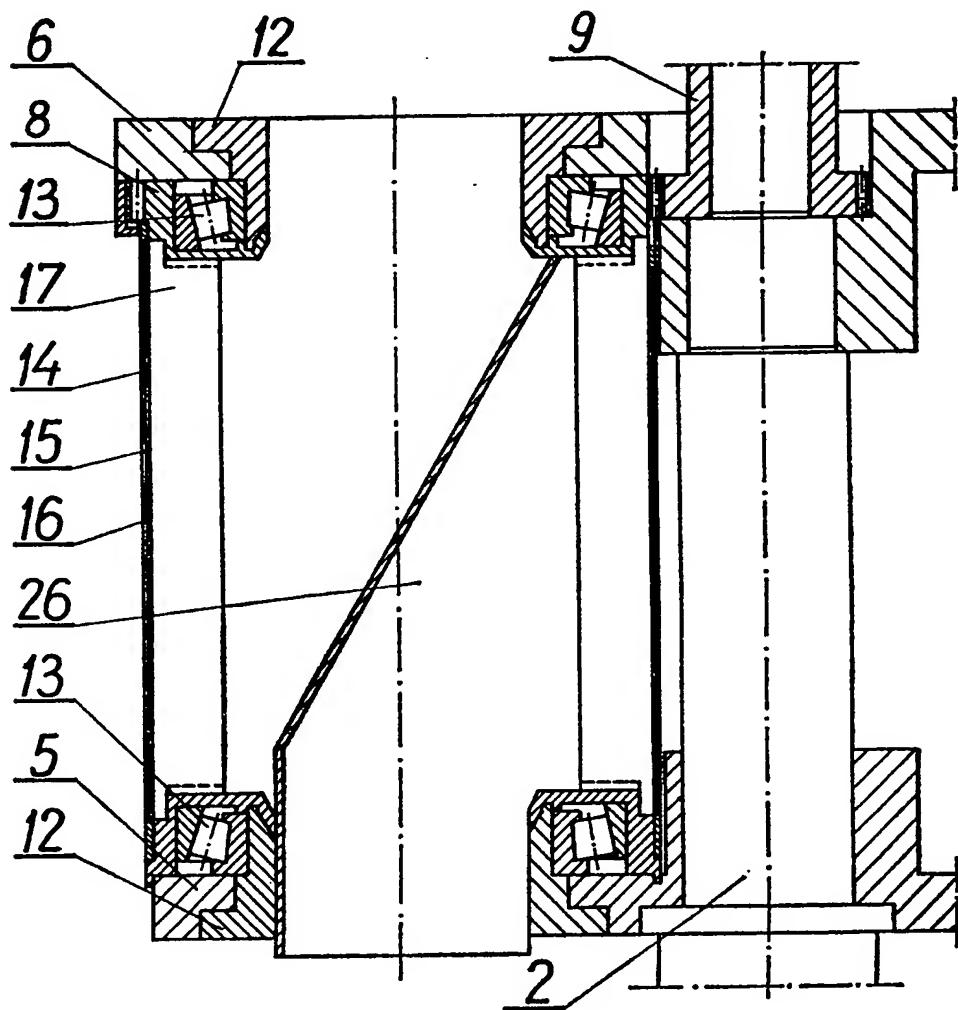


Fig. 2

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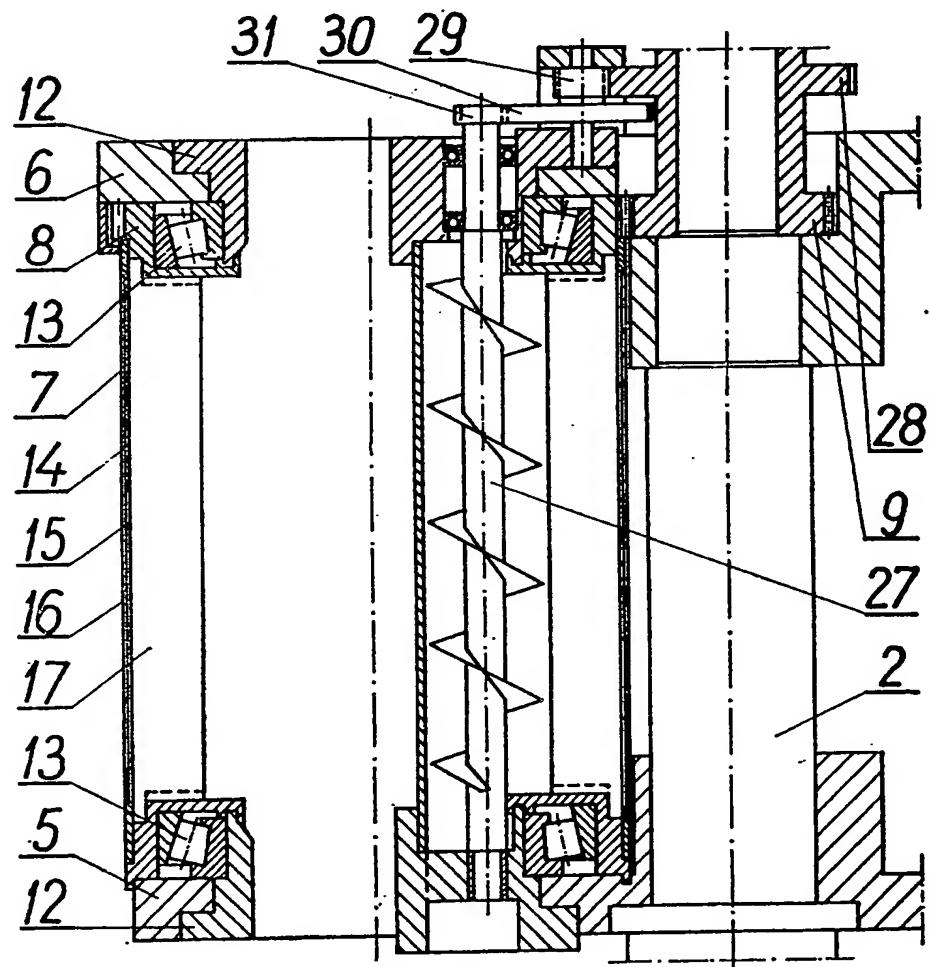


Fig.3

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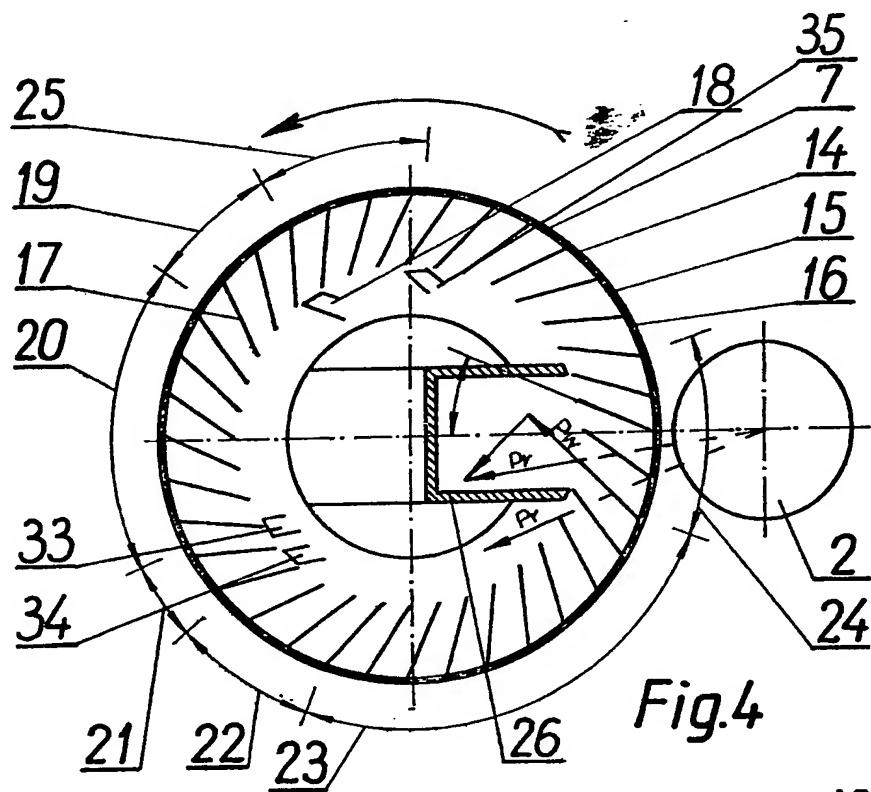


Fig.4

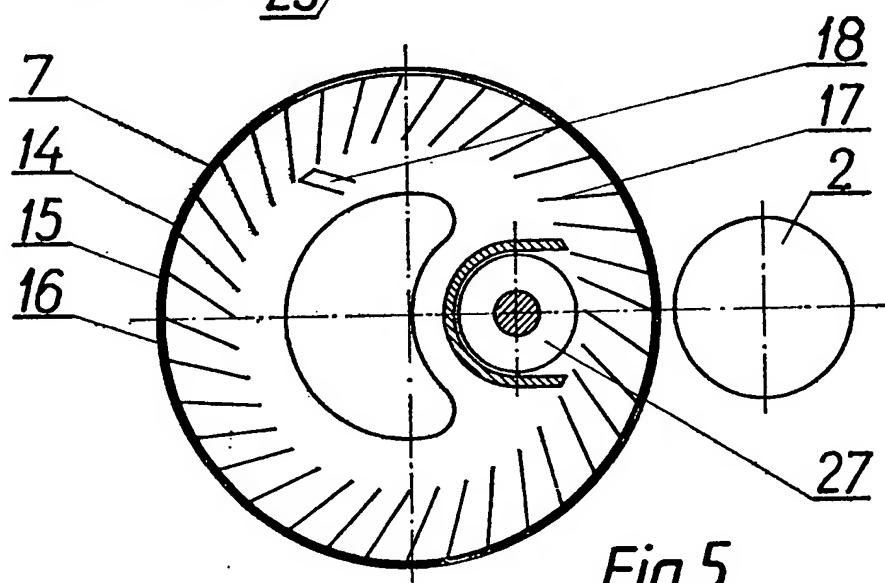


Fig.5

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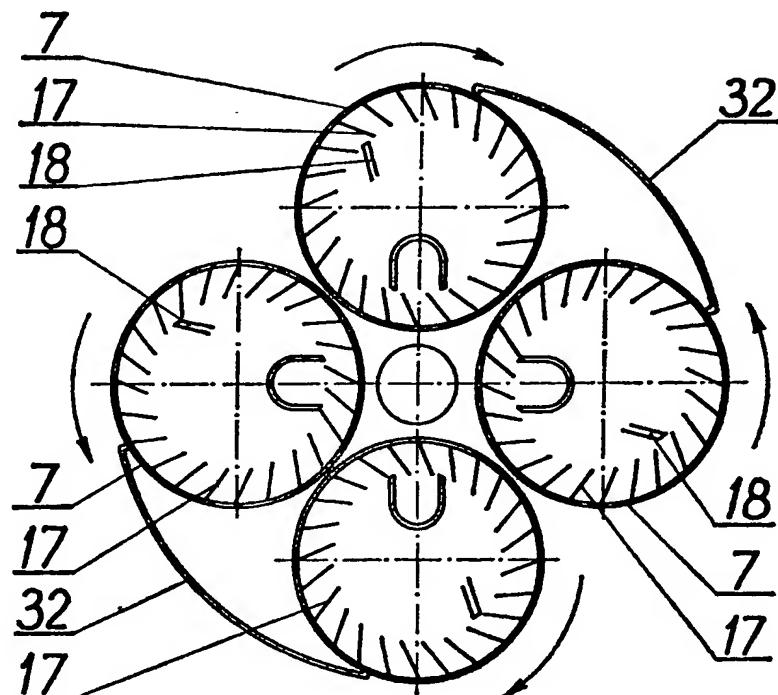


Fig. 6

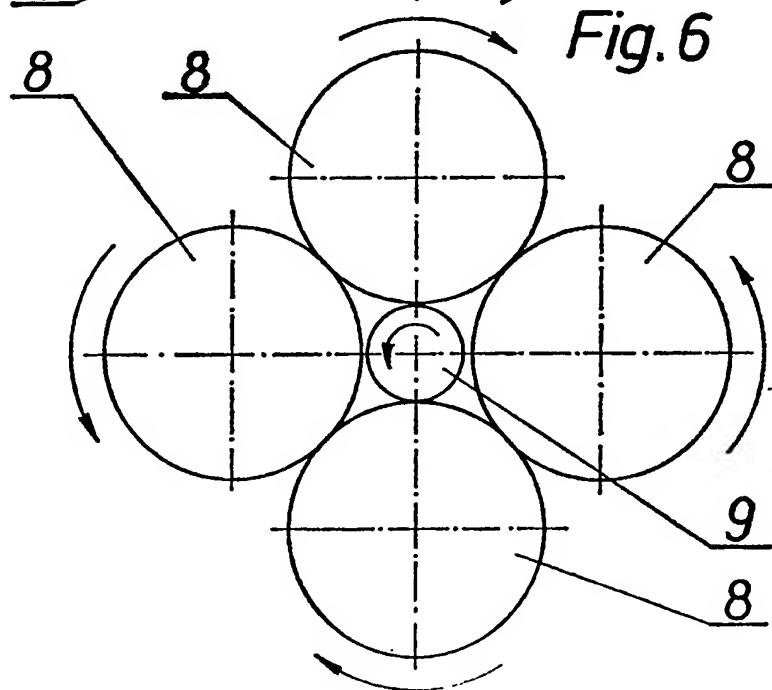


Fig. 7

## SPECIFICATION

## Continuous filtering-settling centrifuge

5 The subject of the invention is a filtering-settling centrifuge designed for continuous separation of mixtures containing liquid and solid bodies and for complete or preliminary drying of granular products. The centrifuge can be applied in chemical, food, and pharmaceutical industries, in processing of minerals, and in sewage treatment.

There are known periodical and continuous centrifuges. Among periodical centrifuges there are known filtering cylindrical vertical and horizontal centrifuges, and settling multi-disc centrifuges. Among continuous centrifuges there are known filtering cylindrical horizontal centrifuges, filtering conical vertical centrifuges, settling multi-disc vertical centrifuges, and settling basket horizontal centrifuges.

The known periodical centrifuges with one cylindrical vertical or horizontal basket, used for separation of mixtures containing solid and liquid bodies, in which the separated solid bodies are discharged cyclically by means of mechanical scraping or sucking-off at low rotations of the centrifuge basket, have the following faults and disadvantages: lack of continuity of the centrifuging process; low output; required high power of drive, connected with cyclic acceleration of the centrifuge basket of large mass - and power losses connected with this; impeded filtration or settling process due to incomplete removal of centrifuged solid bodies at discharge of the centrifuge basket; losses of the centrifuged product due to the necessity of washing out the product which remains in the basket after finishing the discharge; difficulties in centrifuging of viscous solid bodies; difficulty in the application of required technological manipulations – for example washing of centrifuged solid parts; damaging of a part of the product at discharge of the basket; low degree of centrifuging of liquids, connected with the method of discharge of solid bodies; low coefficient of separation of solid bodies; wear and damage of filtrating elements.

45 The known continuous centrifuges with a horizontal basket and with discharge of the centrifuged solid part by means of pushing-out or vibratory mechanisms, and continuous centrifuges with a conical vertical basket and with automatic or mechanical discharge (worm, vibratory, and other mechanisms) of the solid part, have the following disadvantages: low output of separation due to the lack of the possibility of cleaning of the filtration elements; fast wear of the filtration elements and discharging mechanisms; 50 impossibility or serious impedance of separation of the solid parts from viscous liquids; low coefficient of separation of solid bodies from liquids; damages to the crystals of solid bodies, which decrease the quality of the product; high humidity of the centrifuged product; serious difficulty in carrying out technological manipulations of required quality, as for instance washing of the centrifuged solid parts.

The basic disadvantages of the known settling centrifuges with a multi-disc basket, which are emp- 65 tied by means of stopping and dismantling the cen-

trifuge basket, are: the possibility of centrifuging only a small quantity of mixtures containing an inconsiderable percentage of solid bodies; discontinuity of the centrifuging process; low degree of separation of liquids; low coefficient of separating the solid bodies from the liquids.

70 The known settling centrifuges with a multi-disc basket equipped with devices for periodical or continuous discharge, for instance by means of nozzles or slots, are characterised by the following features: low degree of separation of liquids from solid bodies and thus the necessity of applying expensive technological manipulations for further separation of liquid; low coefficient of separation of solid bodies from liquids; additional costs required for the recovery of technological liquids; limited application, depending on the properties of solid bodies and liquids.

75 The known continuous settling centrifuges with a horizontal basket and with a worm discharge device rotating at a speed different from that of the basket, the so-called decantation centrifuges, enable low degree of separation of solid bodies from liquids, are characterised by high wear of the basket and the 80 transporting mechanism, and are used only for a narrow range of mixtures.

85 The aforementioned known centrifuges are single-basket centrifuges. From the German Federal Republic patent specification No. 913638 there is known a centrifuge for extraction of oil from olives, consisting of several baskets rotating around their own axes and suspended in a spinning housing. The baskets of the centrifuge are driven by means of a transmission gear from the main shaft of the centrifuge. The axes of the centrifuge baskets are slightly inclined in relation to the axis of the centrifuge. A granulated mass of olive fruits is fed to the baskets of the centrifuge from underneath. In the baskets of the centrifuge the olives are granulated further and oil is separated. The de-oiled mass is removed from the basket from the top. This centrifuge also has the following disadvantages: range of application is limited only to extraction of oil from olives; the solid parts of the mixture and the elements of baskets are damaged.

90 The object of the present invention is a design of a continuous centrifuge which could perform the tasks imposed upon both the filtering and the settling centrifuges, and which would not have the aforementioned faults and disadvantages.

95 According to the invention there is provided a continuous centrifuge equipped with several filtering or settling baskets which are rotated around their own axes at an angular velocity different from that of the 100 centrifuge, wherein the baskets are bearing-mounted in a lower disc and in an upper disc, driven from a main shaft of the centrifuge by means of a planetary gear and/or a separate motor, the direction of rotation of a part of the baskets being opposite to the direction of rotation of the other part of the baskets, and the baskets have finned partitions set up at an angle of 0-40°, in relation to the transverse axes of the baskets and at an angle of 0-40° in relation to the vertical axes of the baskets, and the centrifuge is 105 equipped with guards being a sector of a cylinder 110

flank, fixed to the lower disc and to the upper disc.

The centrifuge according to the invention is characterised by the following advantages:

- high coefficient of separation of solid bodies

5 from liquids, which is determined by the ratio of the solid bodies content in the centrifuged mixture to the solid bodies content in the effluent, providing for high recovery of the product;

- high degree of complete and preliminary dry-

10 ing of granulated products being centrifuged with high degree of humidity, which enables saving of time, labour and energy losses, as well as investment costs for a heating installation necessary for redrying of the product;

15 — low power requirements for driving the centrifuge, necessary for centrifuging of a volume of the mixture of solid bodies and liquid, or a mass of granulated humid solid bodies — comparable to those of other centrifuges;

20 — minimum losses of expensive technological liquids due to a high degree of centrifuging of solid bodies, i.e. a small content of liquid in the centrifuged product;

- possibility of an easy separation of viscous

25 solid bodies and viscous liquids at a high coefficient of separation, without the occurrence of the phenomenon consisting in gumming up of the centrifuge baskets;

- easy centrifuging with a high coefficient of

30 separation of a mechanically unstable dispersed phase, due to mild acceleration of the mixture of solid bodies and liquids.

The centrifuge according to the invention has application for the following production products and processes:

- polymers — polyethylene, polypropylene, polystyrene, polyacrylate, polyvinyl chloride;

- organic products — sugar, cellulose derivatives, vitamins, organic salts, pharmaceuticals,

40 starch, dextrose, adipic acid, hexamine, carboxymethyl-cellulose, seaweed (in the manufacture of alginates), proteins (at the production of lactose), fishmeal, animal fats;

- Inorganic products — coal, floatation concen-

45 trates of minerals, graphite, coal processing products, magnesite, sodium phosphate, potassium nitrate, zinc sulphate, sodium chloride, iron sulphate, titanium dioxide, kaolin, barium carbonate, barium sulphate, aluminium salts, gilsonite, and the related minerals and products;

- fertilizers — urea, potassium carbonate (potash), ammonium sulphate, calcium nitrate, ammonium nitrate;

- other products and processes — industrial

55 waste treatment, sewage treatment, nitrocellulose, industrial oils and others.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

60 Fig. 1 is a longitudinal section of a sugar centrifuge;

Fig. 2 is a longitudinal section of the filtering basket of the centrifuge with a chute receiver;

Fig. 3 is a longitudinal section of the filtering basket of the centrifuge with a worm receiver;

Fig. 4 is a cross-section of the filtering basket of the centrifuge with a chute receiver;

Fig. 5 is a cross-section of the filtering basket of the centrifuge with a worm receiver;

70 Fig. 6 is a diagrammatic cross-section of the baskets of the centrifuge;

Fig. 7 is a diagram of the drive of the centrifuge baskets.

The centrifuge consists mainly of a body 1, a main shaft 2 bearing-mounted in the known manner in the body, driven by a motor 3 through a belt transmission 4, from a lower disc 5 and an upper disc 6 fixed to the main shaft 2, in which filtering baskets 7 are bearing-mounted, driven around their own axes by

80 means of toothed wheels 8 and 9 and the known planetary gear 10 and/or a separate motor 11.

Cylindrical or slightly conical filtering baskets 7 bearing-mounted by means of covers 12 and bearings 13 is discs 5 and 6 are a ring structure, easy to

85 be produced, consisting of the known perforated or full jacket 14, the known filtering screens 15 and base grids 16, the said structure being additionally equipped with finned partitions 17 fixed to the covers 12, which prevent a displacement of the mixture being

90 filtered and the isolated solid part along the circumference of the filtering baskets 7 during their rotation around their axes. The effect of centrifuging is obtained similarly as in the known centrifuges and it occurs as the result of rotation of the filtering baskets

95 7 around the axis of the main shaft 2, whereas rotations of the filtering baskets 7 around their own axes are utilised for continuous loading of the mixture being centrifuged by means of the known gravitational feeding element 18 in zone 19, for centrifuging

100 of the liquid part in zone 20, for washing and/or steaming of solid part in zone 21 by means of washing agents fed through the known gravitational elements 33 and/or steaming agents fed through the known elements 34, for filtering of a washing agent and/or a steaming agent in zone 22, for drying of the

105 solid part in zone 23, for discharge of solid parts from filtering baskets 7 in zone 24, due to the effect of centrifugal forces —Pr shown in Fig. 4 or their components —Pw, and for washing of filtering screens 15 in zone 25 by means of an agent fed through the known gravitational elements.

The particles of the product being centrifuged do not displace themselves upon filtering screens 15, but only an inconsiderable portion of these particles

115 displaces itself upon smoothly machined finned partitions 17 at low velocity and at inconsiderable pressure, besides, these particles — while leaving the filtering basket 7 — have low velocity in relation to the spinning chute receiver 26 or the worm receiver

120 27, which does not cause abrasion or breakage of particles.

In order to facilitate the removal of liquid from the baskets of the filtering centrifuge, in case of full baskets (non-perforated), finned partitions 17 are set up at an angle of 0-15°, preferably 2-10°, in relation to the vertical axis of the baskets.

Due to a continuous process of centrifuging and the application of technological manipulations, and the possibility of conforming the rotational velocity

130 of filtering baskets 7 around their own axes to the

technological requirements, particles of the product being centrifuged which leave the basket are better centrifuged, washed and dried than it is in the known centrifuges.

5 The subject of the invention is an example of realisation of the settling centrifuge is shown also in Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7, the basket 7 in this realisation having no filtering screens 15 and no base grids 16, and the washing zone 25 being not 10 present therein.

At centrifuging of solid bodies from liquids in the settling centrifuge according to the invention the solid particles and the liquid are under the effect of centrifugal force making the solid particles move in 15 the direction of the basket surface due to their density being higher than that of the liquid. The quantity of solid particles settled on the surface of the basket 7 and on the finned partitions 17 depends on thickness and length of the layer of the liquid and 20 on the velocity of its flow. Possibility of adjusting the flow velocity of the liquid and the fact that thickness of the layer of the liquid being centrifuged decreases in the direction of its outflow, due to the finned partitions 17 being set up at an angle in relation to the 25 vertical axes of the baskets 7 enable obtaining practically any coefficients of separation of solid bodies from liquids even for very small diameters of the solid bodies within the range of 0.5 micrometer.

In the settling centrifuge according to the invention 30 additional technological manipulations can be applied consisting in, for instance, washing of the separated solid part by means of a liquid fed through the known gravitational element 33, or steaming by means of steam fed through the known element 34, both elements being situated in zone 21.

The settling centrifuge according to the invention, in comparison to the known centrifuges, is distinguished by a high output at a high coefficient of separation of solid bodies from liquids, a high degree of 40 separation of liquid from solid bodies, a high quality of the product, due to the possibility of application of additional technological manipulations, and by a wide range of application for the purpose of separation of various types of solid bodies from liquids.

45 In the version of the centrifuge according to the invention, as shown in Figs. 3 and 5, in the discharge zone 24 the worm receiver 27 is applied. The worm receiver 27 is driven from the baskets 7 through the toothed wheels 8, 9, 28, 29, 30, 31.

50 The centrifuge according to the invention can be equipped with the guards 32 being a sector of a cylinder flank — Fig. 6. The version of the centrifuge with the guards 32 operates in the same manner as the centrifuge shown in Figs. 1-5 and 7, and its additional advantage is the possibility of separating the centrifuged liquid part from the liquid used for washing of the solid part due to the application of the guards 32 fixed to the discs 5 and 6.

The above mentioned examples of the application 60 of the invention do not limit all the possibilities of applying the solution according to the invention to the process of separating a mixture of solid bodies from liquid bodies, and to dehydration of granulated solid bodies.

## 65 CLAIMS

1. A continuous centrifuge equipped with several filtering or settling baskets which are rotated around their own axes at an angular velocity different from that of the centrifuge, wherein the baskets are 70 bearing-mounted in a lower disc and in an upper disc, driven from a main shaft of the centrifuge by means of a planetary gear and/or a separate motor, the direction of rotation of a part of the baskets being opposite to the direction of rotation of the other part 75 of the baskets, and the baskets have finned partitions set up at an angle of 0-40°, in relation to the transverse axes of the baskets and at an angle of 0-40° in relation to the vertical axes of the baskets, and the centrifuge is equipped with guards being a sector of 80 a cylinder flank, fixed to the lower disc and to the upper disc.
2. A continuous centrifuge equipped with several filtering baskets according to claim 1 wherein the baskets are equipped with gravitational elements 85 feeding a mixture of solid and liquid bodies, spinning at an angular velocity equal to the angular velocity of the centrifuge, situated in the supply zone, the gravitational elements feeding the washing liquid, and/or the known elements feeding steam for 90 stripping of the solid part, situated in the solid part washing zone, with chute receivers or worm receivers, situated in the discharge zone, and with the known elements feeding the washing liquid in the washing zone of the filtering screens.
- 95 3. A continuous centrifuge equipped with several filtering baskets according to claim 1 wherein the baskets are equipped with the gravitational elements feeding a mixture of solid and liquid bodies, spinning at an angular velocity equal to the angular velocity of the centrifuge, situated in the feeding zone, and with chute receivers or worm receivers situated in the discharge zone.
- 100 4. A continuous centrifuge equipped with several settling baskets according to claim 1 wherein the baskets are equipped with the gravitational elements feeding a mixture of solid and liquid bodies, situated in the feeding zone and spinning at an angular velocity equal to the angular velocity of the centrifuge, with the gravitational elements feeding the washing liquid and/or with the elements feeding steam in the zone of washing the solid part, with chute receivers or worm receivers situated in the discharge zone.
- 105 5. A continuous centrifuge equipped with several settling baskets according to claim 1 wherein the baskets are equipped with the gravitational elements feeding a mixture of solid and liquid bodies, situated in the feeding zone and spinning at an angular velocity equal to the angular velocity of the centrifuge, 110 with the gravitational elements feeding steam in the zone of washing the solid part, with chute receivers or worm receivers situated in the discharge zone.
- 115 6. A continuous centrifuge substantially as hereinbefore described with reference to Figs 1, 2, 4, 6 and 7 of the accompanying drawings.
- 120 7. A continuous centrifuge substantially as hereinbefore described with reference to Figs. 1, 3, 5, 6 and 7 of the accompanying drawings.